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Rehabilitation Of Multi Storey Residential Building

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Abstract — *In this project we are going to rehabilitate the residential tenements and regenerate it. Basically repair is a part of the rehabilitation. The condition of few tenements are very poor, there is major repair work required. Due to ongoing urbanization, population lives in city, which is already built and has aging effect, so they need to attend both sustainable rehabilitation of the tenements and the eco-friendly for existing urban environment. So, our project focuses on rehabilitation of residential tenements, we are going to discuss the new and innovative building services, engineering systems, which could contribute to increase energy efficiency, resource productivity, and urban resilience.*

Keywords-*Rehabilitation, Repair, Non-Destructive Test, Increasing Strength of Building, Increase life of Building*

I. INTRODUCTION

We generally think of concrete as a modern building material, yet it is one of the oldest and most durable building materials. Although the Romans experimented with bronze reinforcement, reinforced concrete as we know it today dates from the mid-19th century following the introduction of Portland cement concrete in 1854. Steel has the advantage of having the tensile strength that concrete lacks, and is highly compatible with its chemical and physical characteristics. The matching of thermal expansion coefficients is critical to the versatility of reinforced concrete.

Traditional methods of corrosion protection, such as concrete admixtures and passive barrier systems, may not be sufficient to provide the level of corrosion control needed for the intended design life. As a solution to this problem, the use of cathodic protection (or cathodic prevention as it is called) at the time of construction is proposed. Although cathodic protection has been used as a rehabilitation method for existing salt-contaminated concrete structures for over 25 years, its application to new reinforced concrete structures is relatively new.

II. BACKGROUND

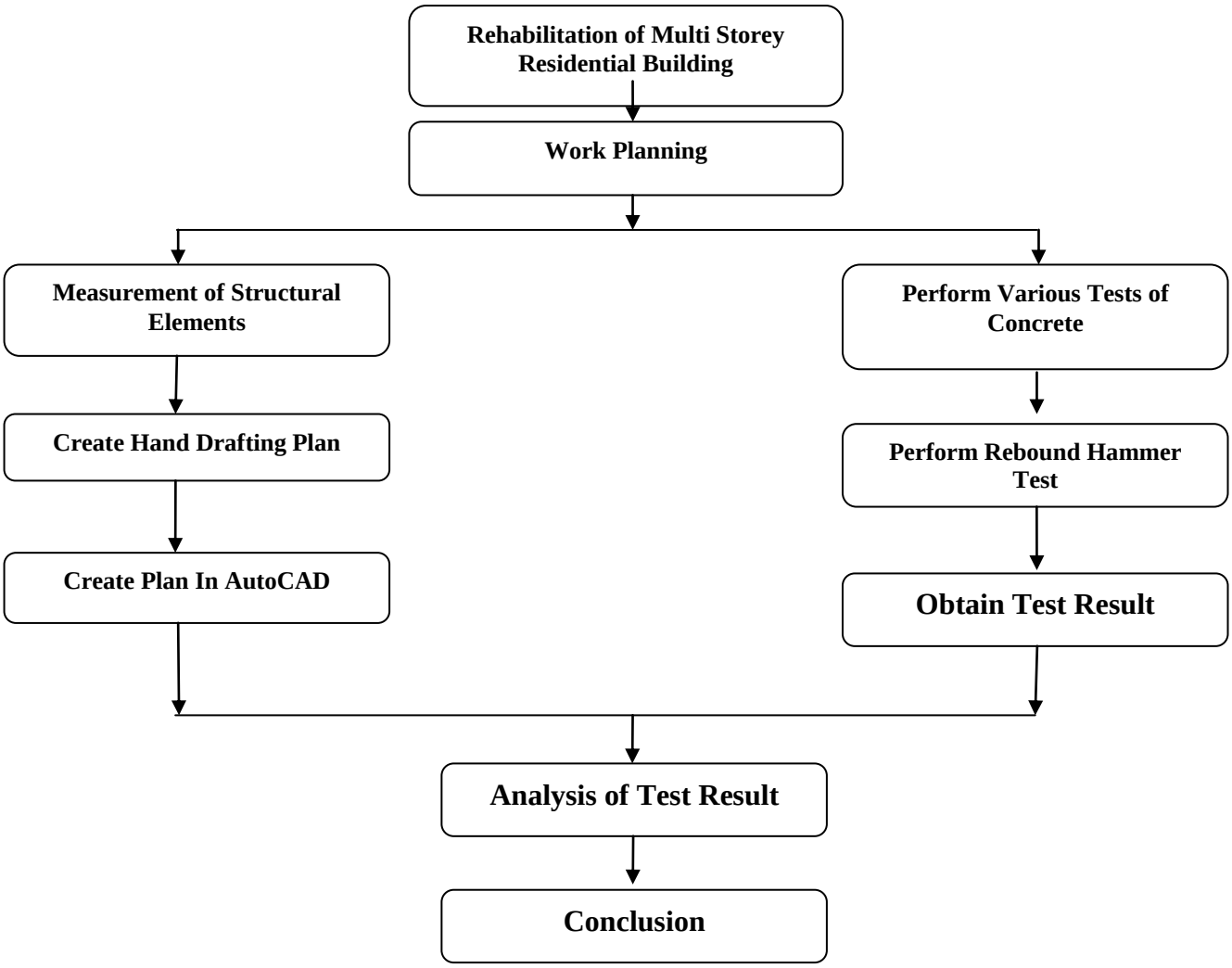
Rehabilitation is concepts of evaluation of existing structures; strength, durability and deficiencies, destructive & non-destructive testing, damaged structures & deterioration mechanisms, materials, criteria & techniques for repairing and strengthening of concrete structures.

Concrete is the most commonly used & versatile construction material possessing several benefits over steel & other construction materials. However, very often one came across with some defects in concrete. The defects may noticeable themselves in the form of cracks, exposure of reinforcement, spalling of concrete, excessive deflections or other marks of distress. On many incidents, corrosion of reinforcement may cause off cracking and spalling of concrete, linked with deterioration in the strength of the structure. Such conditions call for repairs of affected zones & sometimes for the replacement of the entire structure.

So, the need of rehabilitation arises and the rehabilitation process starts after above mentioned points or any disasters.

III. MATHEDOLOGY

- Perform Non Destructive tests, namely; Rebound Hammer test, Ultrasonic Pulse Velocity test
- Interpretation of results obtained from NDT testing
- Remedial measures for repair of building



IV. RESULT AND ANALYSIS

4.1 REBOUND HAMMER TEST RESULT

Table 1 Rebound hammer test result

SITE ADDRESS:- Sahnip park, Nr.Divya Shoes, Adajan								REPORT NO:- 1		
RESULT OF REBOUND HAMMER TEST										
GROUND FLOOR										
SR NO.	MEMBER	LOCATION IDENTIFICATION	REBOUND HAMMER READING						AVG. READING	CUBE COMPRESSIVE STRENGTH	QUALITY OF CONCRETE
			1	2	3	4	5	6			
1	COLUMN	A1	25	19	20	22	23	20	21	0	FAIR
2	COLUMN	A2	38	36	34	30	32	32	35	19.2	GOOD LAYER
3	COLUMN	A3	44	42	40	38	38	38	40	23.9	GOOD LAYER
4	COLUMN	A4	23	20	22	19	20	21	21	0	FAIR
5	COLUMN	A5	30	30	33	31	36	30	28	15.1	FAIR
6	COLUMN	A6	26	25	24	28	25	20	24	14.3	FAIR
7	COLUMN	A7	36	36	35	31	32	33	34	19	GOOD

											LAYER
8	COLUMN	A8	36	33	32	35	36	31	34	19	GOOD LAYER
9	COLUMN	A9	44	40	42	43	42	40	42	28.7	HARD LAYER
10	COLUMN	A10	33	35	38	36	32	35	35	19.2	GOOD LAYER
11	COLUMN	B1	37	36	32	36	36	35	35	19.2	GOOD LAYER
12	COLUMN	B2	20	26	21	22	23	24	23	13	FAIR
13	COLUMN	B3	31	34	36	33	35	36	34	19	GOOD LAYER
14	COLUMN	B4	28	27	23	30	28	25	27	14.9	FAIR
15	COLUMN	B5	20	18	20	15	15	16	18	0	POOR
16	COLUMN	C1	25	22	29	28	27	24	26	14.7	FAIR
17	COLUMN	C2	25	26	23	22	21	29	24	14.3	FAIR
18	COLUMN	C3	36	33	32	35	36	31	34	19	GOOD LAYER
19	COLUMN	D1	36	36	35	31	32	33	34	19	GOOD LAYER
20	COLUMN	D2	20	21	25	26	28	30	24	14.3	FAIR
21	COLUMN	D3	44	42	40	38	38	38	40	23.9	GOOD LAYER
22	COLUMN	D4	25	19	18	22	17	20	19	0	POOR
23	COLUMN	E1	44	40	43	42	41	40	42	28.7	HARD LAYER
24	COLUMN	E2	26	25	24	28	25	20	24	14.3	FAIR
25	COLUMN	E3	37	36	32	36	36	35	35	19.2	GOOD LAYER
26	COLUMN	E4	25	22	29	28	27	24	26	14.7	FAIR
27	COLUMN	E5	25	12	20	20	23	19	20	0	POOR
28	COLUMN	E6	33	35	38	36	32	35	35	19.2	GOOD LAYER
29	COLUMN	E7	28	27	19	25	23	20	19	0	POOR
30	COLUMN	E8	31	34	36	33	35	36	34	19	GOOD LAYER
31	COLUMN	E9	20	20	20	21	18	17	20	0	POOR
32	COLUMN	E10	28	27	23	36	28	25	27	14.9	FAIR
33	COLUMN	E11	36	33	32	35	36	31	34	19	GOOD LAYER
34	COLUMN	E12	30	34	33	31	36	30	28	15.1	FAIR

NOTE:-Test results are location specific. Rebound hammer test use only for relative strength evaluation not for absolute strength.

Table 2 Criteria for quality of concrete by rebound number

Average Rebound Number	Quality of Concrete
> 40	Very Good Hard layer
30 to 40	Good layer
20 to 30	Fair
< 20	Poor Concrete
0	Delaminated

4.2 ULTRASONIC PULSE VELOCITY TEST RESULT

NOTE:- Test Results Are Location Specific

Following remarks are applicable for 'direct method' as per IS 13311 (part2) 1992

1. Velocity below 3.0 km/sec indicates **'DOUBTFUL'** quality concrete.
2. Velocity between 3.0 to 3.5 km/sec indicates **'MEDIUM'** quality concrete.
3. Velocity between 3.5 to 4.5 km/sec indicates **'GOOD'** quality concrete.
4. Velocity above 4.5 km/sec indicates **'EXCELLENT'** quality concrete

Table 3 Ultrasonic pulse velocity result

SITE ADDRESS:- Sahnip park, Nr.Divya Shoes, Adajan						**REPORT NO:- 1**	
RESULT OF ULTRASONIC PULSE VELOCITY TEST							
GROUND FLOOR							
SR NO.	**MEMBER**	**LOCATION IDENTIFICATION**	**METHOD APPLY**	**DISTANCE (mm)**	**TRANSIT TIME (µsec)**	**U.P.V (Km/Sec)**	**CONCRETE QUALITY GRADING**
1	COLUMN	A1	Direct	584.2	393	1.5	Doubtful
2	COLUMN	A2	Direct	508	190	2.7	Doubtful
3	COLUMN	A3	Direct	762	576	1.3	Doubtful
4	COLUMN	A4	Direct	393.7	225.8	1.7	Doubtful
5	COLUMN	A5	Direct	482.6	300	1.6	Doubtful
6	COLUMN	A6	Semi-Direct	419.1	120.4	3.5	Good
7	COLUMN	A7	Indirect	406.4	198	2.1	Doubtful
8	COLUMN	A8	Direct	482.6	220	2.2	Doubtful
9	COLUMN	A9	Direct	584.2	190	3.1	Satisfactory
10	COLUMN	A10	Direct	431.8	98	4.4	Excellent
11	COLUMN	B1	Direct	482.6	280	1.8	Doubtful
12	COLUMN	B2	Direct	482.6	290	1.7	Doubtful
13	COLUMN	B3	Direct	482.6	270	2.8	Doubtful
14	COLUMN	B4	Direct	482.6	210	2.3	Doubtful
15	COLUMN	B5	Direct	558.8	174.6	3.2	Satisfactory
16	COLUMN	B6	Indirect	482.6	156.6	3.1	Satisfactory
17	COLUMN	B7	Direct	490.2	381	1.3	Doubtful
18	COLUMN	B8	Direct	482.6	275.3	1.8	Doubtful
19	COLUMN	B9	Direct	482.6	280	1.8	Doubtful
20	COLUMN	C1	Direct	482.6	262.1	1.9	Doubtful
21	COLUMN	C2	Direct	558.8	408.3	1.4	Doubtful
22	COLUMN	C3	Direct	558.8	250.6	2.2	Doubtful
23	COLUMN	C4	Direct	558.8	120	4.6	Excellent
24	COLUMN	C5	Direct	558.8	570	0.9	Doubtful
25	COLUMN	C6	Direct	482.6	250.9	1.9	Doubtful
26	COLUMN	D1	Direct	482.6	243	1.9	Doubtful
27	COLUMN	D2	Direct	482.6	280	1.7	Doubtful
28	COLUMN	D3	Direct	457.2	260	1.8	Doubtful
29	COLUMN	D4	Semi Direct	482.6	230	2.1	Doubtful
30	COLUMN	D5	Direct	548.2	360	1.5	Doubtful

31	COLUMN	D6	Direct	482.6	130	3.7	Good
32	COLUMN	D7	Indirect	482.6	400	1.2	Doubtful
33	COLUMN	D8	Direct	482.6	310	1.6	Doubtful
34	COLUMN	D9	Direct	482.6	155	3.1	Satisfactory
35	COLUMN	E1	Direct	419.1	145	2.9	Doubtful
36	COLUMN	E2	Direct	584.2	157.9	3.8	Good
37	COLUMN	E3	Direct	482.6	372	1.3	Doubtful
38	COLUMN	E4	Semi Direct	393.7	115	3.4	Satisfactory
39	COLUMN	E5	Semi Direct	406.4	279	1.5	Doubtful
40	COLUMN	E6	Direct	635	500	1.3	Doubtful
41	COLUMN	E7	Indirect	419.1	389	1.07	Doubtful
42	COLUMN	E8	Semi Direct	406.4	200	2	Doubtful
43	COLUMN	E9	Semi Direct	393.7	240	1.6	Doubtful
44	COLUMN	E10	Direct	495.3	190	2.6	Doubtful
45	COLUMN	E11	Semi Direct	571.5	140	4.1	Excellent
46	COLUMN	E12	Direct	419.1	350.2	1.19	Doubtful
47	BEAM	A1+B2	Direct	419.5	160	1.6	Doubtful
48	BEAM	D3+C3	Semi Direct	420.6	190	2.2	Doubtful

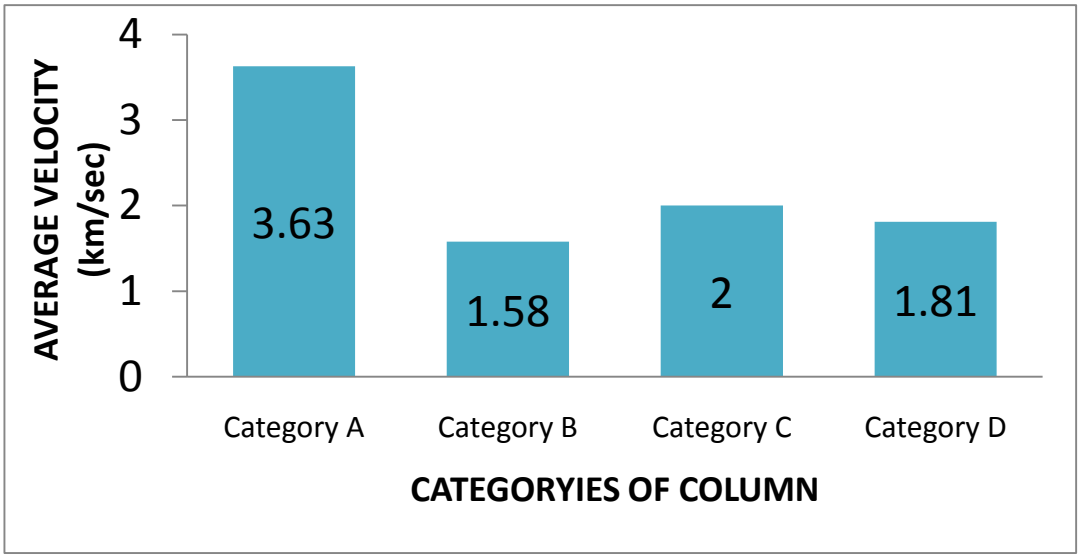
4.3 STRUCTURAL MEMBERS CAN BE DIVIDED INTO FOLLOWING CATEGORIES BASED ON THEIR CONDITIONS

Table 4 Categories of structural member based on their condition

Category of members	Condition	Location Identification
A	Structural members with initial good condition and negligible effect	A10, C4, E11
B	Columns showing loss of strength due to aging and flood	A9, A6, B5, B6, D6, D9,E2, E4
C	Structural members showing loss of strength due to leakage in drainage system	A3, A4, B3, B5, D2, E1, E3
D	Columns supporting Sunk slabs	A5, A8, E5, E8, E9 ,E11, E12, D8, C5, B2

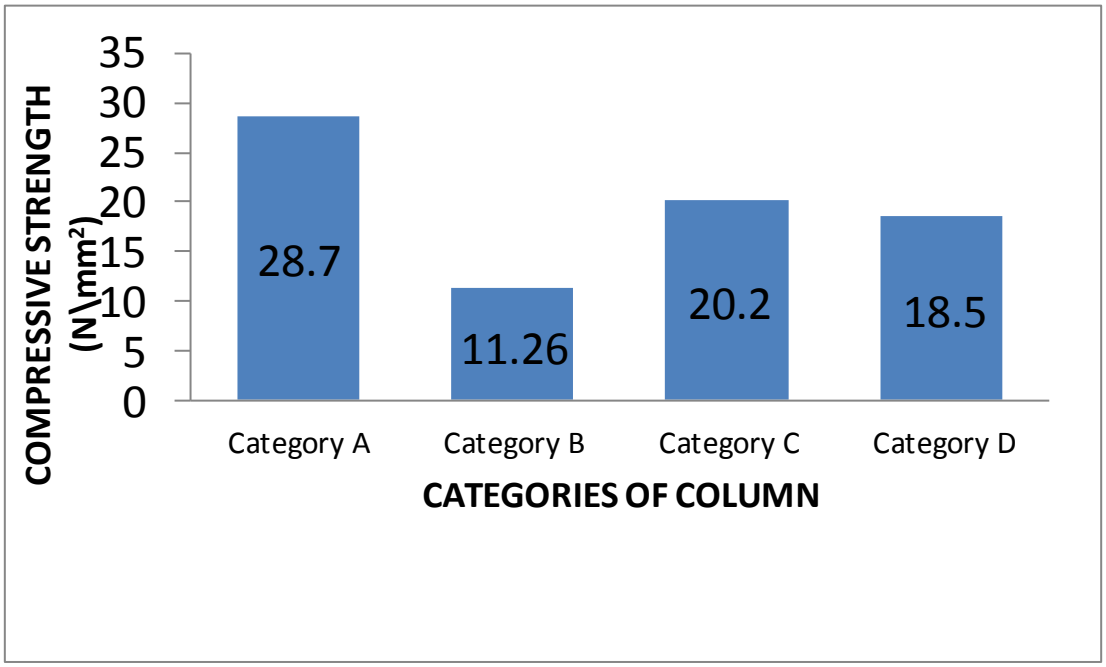
4.4 ULTRASONIC PULSE VELOCITY TEST ANALYSIS

Table 5 Analysis of UPV test



4.5 REBOUND HAMMER TEST ANALYSIS

Table 6 Analysis of rebound test



4.6 RESULT DISCUSSION

Following observations were made from the test results.

- Category D members have low strength compare to category A members, as pulse velocity obtained from UPV test is 10-15% lower for category D members.
- Bottom portion(up to 1m from ground) of category B members are weaker than top potion of the columns, as pulse velocity obtained from UPV test is 50-55% lower for bottom portion.
- Moreover, bottom portion (up to 1m from ground level) of category B members has pulse velocity 45-50% lower than category A members and this indicates flood damage.
- Category C members have low strength compare to category A members, as compressive strength obtained from Rebound Hammer test is 30% lower than average.

4.7 CONCLUSION OF ANALYSIS

Following conclusions are drawn based on the present project work.

- Comparative compressive strength of category A members is noted 45-50% higher than category B members.
- For category B columns compressive strength of bottom portion (up to 1m from ground level) is noted 20-25% lower than top portion (above 1m from ground level) of respective columns.
- Comparative compressive strength of category A members is noted 5-10% higher than category D members.
- As per testing results slabs and beams are found in good condition.
- These results obtained from tests will helps in performing Push over analysis which is essential for further repair and rehabilitation of the building.

V. STRUCTURAL LAYOUT

Figure 1 Deterioration of concrete in column, slab, beam

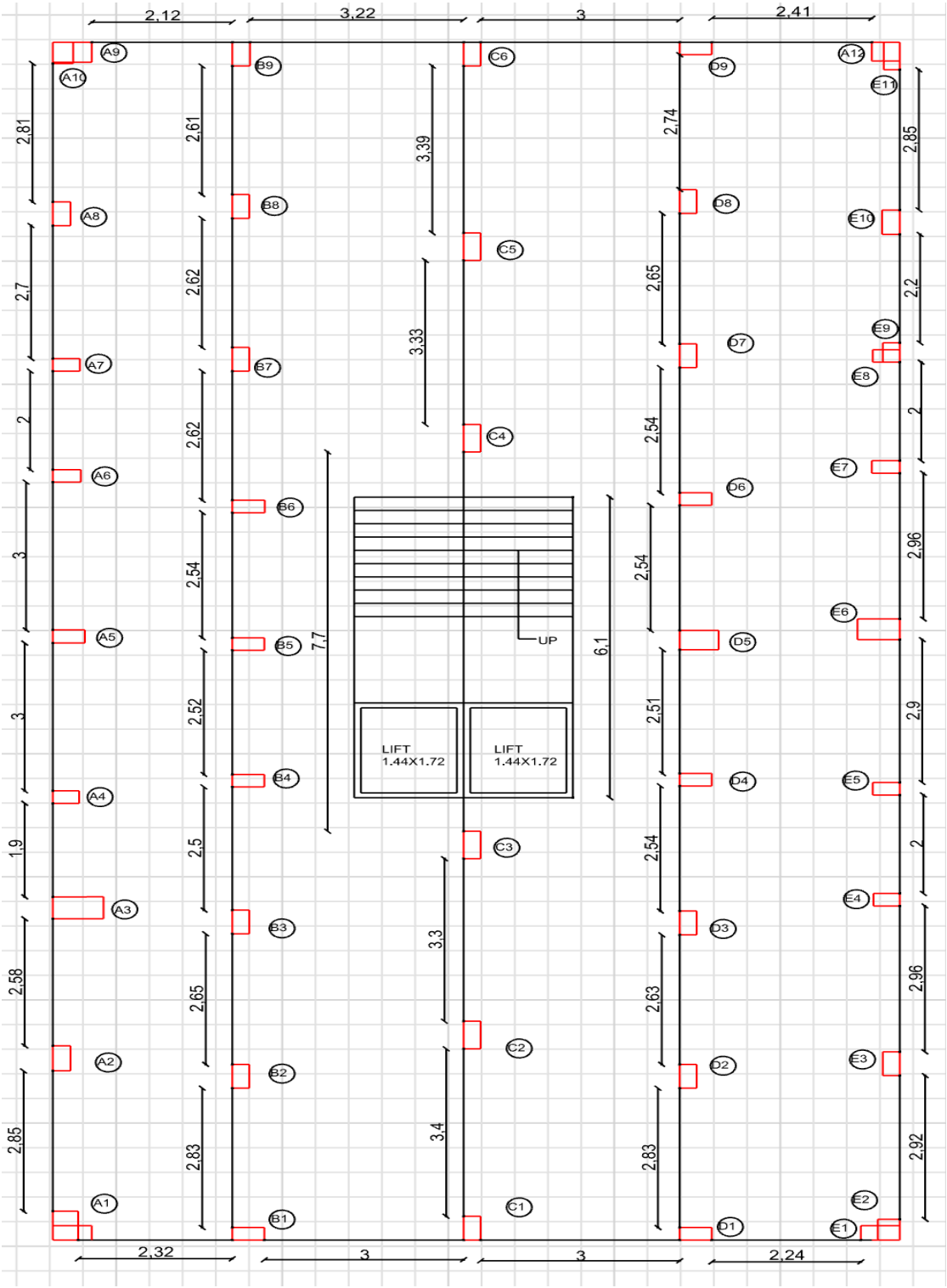


Figure 2 Structural plan of building

VI. CONCLUSION

- Measure the Column Size and end to end distance of column
- Make the structural plan of Sahnip Park
- Rebound Hammer Test perform on various columns
- Ultrasonic Pulse Velocity Test perform on various column and beams

After this remarks finalised the condition of slab are all good and 50% of beams are in good condition.50% no. Of columns are supporting sunk slab and affected with ages and flood. But, some few columns are affected by leakage problem of drainage.

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